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The effects of surface reconstruction and electron-positron correlation on the annihilation characteristics of positrons trapped at semiconductor surfaces

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Abstract

Experimental positron annihilation induced Auger electron spectroscopy (PAES) data from Ge(100) and Ge(lll) surfaces display several strong Auger peaks corresponding to M4,5N1N2,3, M 2,3M44,5M4,5, M2,3M4,5V, and M1M4,5M4,5 Auger transitions. The integrated peak intensities of Auger transitions have been used to obtain experimental annihilation probabilities for the Ge 3d and 3p core electrons. The experimental data were analyzed by performing theoretical studies of the effects of surface reconstructions and electron-positron correlations on image potential induced surface states and annihilation characteristics of positrons trapped at the reconstructed Ge(100) and Ge(lll) surfaces. Calculations of positron surface states and annihilation characteristics have been performed for Ge(100) surface with (2x1), (2x2), and (4x2) reconstructions, and for Ge(lll) surface with c(2x8) reconstruction. Estimates of the positron binding energy and annihilation characteristics reveal their sensitivity to the specific atomic structure of the topmost layers of the semiconductor and to the approximations used to describe electron-positron correlations. The results of these theoretical studies are compared with the ones obtained for the reconstructed Si(100)-(2xl) and Si(lll)-(7x7) surfaces. © 2009 American Institute of Physics.

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Keywords

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